Wilkinson Microwave Anisotropy Probe 7-yr constraints on f_{NL} with a fast wavelet estimator

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Abstract

A new method to constrain the local non-linear coupling parameter f_{NL} based on a fast wavelet decomposition is presented. Using a multiresolution wavelet adapted to the HEALPix pixelization, we have developed a method that is $\sim 10^2$ times faster than previous estimators based on isotropic wavelets and $\sim 10^3$ faster than the KSW bispectrum estimator, at the resolution of the Wilkinson Microwave Anisotropy Probe (WMAP) data. The method has been applied to the WMAP 7-yr V+W combined map, imposing constraints on f_{NL} of $-69 < f_{\mathrm{NL}} < 65$ at the 95 per cent CL. This result has been obtained after correcting for the contribution of the residual point sources which has been estimated to be $\Delta f_{\mathrm{NL}} = 7 \pm 6$. In addition, a Gaussianity analysis of the data has been carried out using the third order moments of the wavelet coefficients, finding consistency with Gaussianity. Although the constraints imposed on f_{NL} are less stringent than those found with optimal estimators, we believe that a very fast method, as the one proposed in this work, can be very useful, especially bearing in mind the large amount of data that will be provided by future experiments, such as the Planck satellite. Moreover, the localisation of wavelets allows one to carry out analyses on different regions of the sky. As an application, we have separately analysed the two hemispheres defined by the dipolar modulation proposed by Hoftuft et al. (2009, ApJ, 699, 985). We do not find any significant asymmetry regarding the estimated value of f_{NL} in those hemispheres.